

REMARKS

Upon entry of this amendment, claims 1-3, 5-7, and 9-22 will be pending.

Claims 1, 7, 9-11, 14, 20, and 21 have been amended. Claims 4 and 8 have been cancelled. No new matter is being introduced by the current amendments.

Claim Objections

Applicants respectfully request reconsideration of the objection to claims 4-22 under 37 CFR 1.75(c) as being in improper form in view of multiple dependent claims 4-8, 10, 12-16, and 18-21 depending on multiple dependent claims. Except for dependent claim 15, applicants removed all multiple dependencies from the original claims in Preliminary Amendment A Prior to Examination filed with the national stage application papers on April 28, 2006. Accordingly, the objection is erroneous and should be withdrawn.

Rejection Under 35 U.S.C. 112, Second Paragraph

Applicants respectfully request reconsideration of the rejection of claim 11 as being indefinite. The Office asserts that it is unclear where the heater(s) is located. Claim 10, from which claim 11 depends, has been amended to specify that the esterification zone comprises one or more reactors. Claim 11 has been amended to require that the one or more heaters are located in the or each reactor close to the feed point. It is respectfully submitted that the claims 10 and 11, as amended, specify with sufficient certainty the location of the heater(s). The precise location of the heater(s) will be a function of the feed, the size and configuration of the reactor, ergonomics,

etc., but the heater(s) are located close to the point at which the feed enters the one or more reactors.

Rejections Under 35 U.S.C. §102 and §103

Claim 1, as amended, is directed to a process for the diesterification of C₄ dicarboxylic acids by reaction of the dicarboxylic acid with methanol in the presence of water of solution. The process comprises:

- (a) providing a solution comprising the dicarboxylic acid and the water of solution;
- (b) reacting the solution of the dicarboxylic acid in an esterification zone with methanol to form an ester and water of esterification, the esterification being conducted at temperatures of from 65 to 150°C and pressures from 1 to 5 bar in a two-stage process;
- (c) removing the water of solution and the water of esterification; and
- (d) recovering the ester.

Cooley et al.

Applicants respectfully request reconsideration of the rejection of claims 1, 2, 4, 5, 10, 12, 16, 17, 20 and 21 under 35 U.S.C. §102(b) in view of U.S. Patent No. 4,032,458 to Cooley et al. (Cooley et al.)

Cooley et al. disclose a process for the production of 1,4-butanediol from maleic acid in which a maleic acid-containing feedstock is introduced into a distillation zone in the presence of a monohydric alcohol to produce a dialkyl ester product. The dialkyl ester product is further converted to 1,4-butanediol. Monohydric alcohols utilized in preparation of the dialkyl ester

of maleic acid include monohydric alcohols having from 2 to about 10 carbon atoms. (See, for example, col. 2, lines 46-49)

Claim 1, as amended, requires, *inter alia*, reacting a dicarboxylic acid with methanol. Nowhere do Cooley et al. disclose utilizing methanol for preparation of the dialkyl ester of maleic acid. Accordingly, it is respectfully submitted that claim 1 is novel over the cited reference. It is further respectfully submitted that claims 2, 5, 10, 12, 16, 17, 20 and 21 depending directly or indirectly from claim 1 are likewise novel over the cited reference based on the reasons set forth above concerning claim 1 and the additional limitations incorporated therein.

Cooley et al. and Turner et al.

Applicants further respectfully request reconsideration of the rejection of claims 1-5, 10-12 and 16-21 under 35 U.S.C. §103(a) in view of Cooley et al. and U.S. Patent No. 4,751,334 to Turner et al. (Turner et al.)

In order to establish a *prima facie* case of obviousness, the Patent Office must establish that the reference, or references when combined, teach or suggest each and every claim limitation.

As noted, Cooley et al. disclose a process for preparation of 1,4-butanediol that includes preparation of a dialkyl ester of maleic acid by reacting maleic acid with a monohydric alcohol having from 2 to about 8 carbons. Turner et al. disclose preparation of 1,4-butanediol by the vapor phase hydrogenolysis of an alkyl ester of a C₄ dicarboxylic acid utilizing a reduced copper-chromium or copper-zinc mixed oxide catalyst. Nowhere do Turner et al. disclose utilizing methanol for preparation of the

alkyl ester of the dicarboxylic acid. Accordingly, it is respectfully submitted that the combination of references relied on by the Office fails to disclose each limitation of claim 1.

Furthermore, it is respectfully submitted that it would not have been obvious to one of skill in the art to modify the process of either reference to arrive at the process defined in claim 1. For example, Cooley et al. describe a preference for the esterification alcohol as forming an azeotrope with water and, more preferably an esterification alcohol that forms a heterogeneous azeotrope. (See, for example, col. 2, lines 42-45 and 49-57 of Cooley et al.) Methanol does not form an azeotrope with water, thereby aiding in water removal from the esterification zone. As noted in applicants' specification removal of the "water of esterification" drives the equilibrium in favor of ester production since the presence of water will drive the equilibrium away from ester formation (See, for example, page 1, lines 5-10 of applicants' specification, WO 2005/051885). Removal of water will be more difficult in the case of an azeotroping monohydric alcohol as utilized by Cooley et al. and, accordingly, increase energy costs associated with the process. Nowhere do Cooley et al. recognize this issue and, accordingly, the disclosure of Cooley et al. would not have made it obvious to one skilled in the art to utilize methanol as required in claim 1.

Turner et al. do not describe the method for preparing the dialkyl ester. The only mention of methanol is in connection with dilution of the ester to provide the dehydrogenation feedstock. (See, for example, col. 4, lines 61-63) Accordingly, the disclosure of Turner et al. likewise would not

have made it obvious to one skilled in the art to utilize methanol in the esterification as required in claim 1.

Accordingly, it is respectfully submitted that claim 1 is not obvious in view of the disclosure of Cooley et al. in view of the disclosure of Turner et al. It is further respectfully submitted that claims 2, 3, 5, 10-12 and 16-21 that depend directly or indirectly from claim 1 are not obvious in view of this combination of references for the reasons set forth above regarding claim 1 and the additional limitations which they introduce.

Schwartz et al.

Applicants further respectfully request reconsideration of the rejection of claims 1, 2, 4, 5, 7-10, 12, 20 and 21 under 35 U.S.C. §102(b) in view of GB 1,437,898. (Schwartz et al.)

Schwartz et al. disclose a process for the preparation of maleic acid esters that comprises reacting maleic acid with a monohydric alcohol. A first stage is described in which an aqueous solution of maleic acid is reacted and dehydrated with a monohydric alcohol in a distillation column. Water is removed overhead and a mixture comprising monohydric alcohol diesters and monoesters of maleic acid are removed as a bottoms product. A second stage is described in which the mixture comprising diesters and monoesters of maleic acid is reacted with an alcohol. Monohydric alcohols that may be employed are described as primary, secondary, and tertiary alcohols having from 1 to 18 carbon atoms, preferably from 4 to 18 carbon atoms, and more preferably from 4 to 8 carbon atoms.

With regard to operating conditions, Schwartz et al. state that the pressure of the first stage may range from

subatmospheric, atmospheric, or above atmospheric pressure. A general preference for a first stage pressure of about atmospheric pressure or up to 100 psig (approx. 8 bar). The first stage temperature is generally described as sufficient to cause boiling. (See, for example, page 3, lines 9 to 23) Schwartz et al. describe the second stage pressure as at least 25 psig (approx. 1.7 bar), up to 200 psig (approx. 14 bar), and preferably between about 40 and 150 psig (approx. 2.8 to 10.3 bar). (See, for example, page 3, lines 49-52) The second stage operating temperature is generally described as from 100°C to about 250°C, or within the range of from about 100°C to about 230°C. (See, for example, page 3, lines 55-59)

Example 1 utilizes n-butanol as the monohydric alcohol and is operated under a first stage pressure of atmospheric, a first stage temperature ranging from 120-170°C, a second stage pressure of from approximately 56 to 46 psig (approx. 3.8 to 3.1 bar), and a second stage temperature of approximately 190°C.

Example 2 utilizes n-butanol as the monohydric alcohol and is generally operated under conditions of Example 1. However, the first stage temperature is maintained at from 155-160°C for a portion of the first stage, and the pressure of the second stage is maintained at approximately 56 psig (approx. 3.8 bar) during distillation.

Example 3 utilizes n-hexanol as the monohydric alcohol. The first stage is operated under the conditions of Example 1 and the second stage is operated under a pressure sufficient to maintain the temperature at approximately 190°C.

Example 4 utilizes n-hexanol as the monohydric alcohol and is operated under the conditions of Example 1.

As noted, claim 1, as amended, requires reacting a solution comprising the dicarboxylic acid and the water of solution with methanol in a two-stage process (1) at temperatures of from 65 to 150°C and (2) pressures from 1 to 5 bar. The general disclosure of Schwartz et al. includes operating conditions for the first and second stage that overlap the claimed operating ranges for temperature and pressure. However, the specific disclosure of the working examples do not specify a two-stage process in which each stage is operated under the conditions specified in claim 1. In addition, the working examples do not include an example in which methanol is utilized as the monohydric alcohol. Accordingly, it is respectfully submitted that the disclosure of Schwartz et al. does not anticipate the process defined in claim 1. (See, for example, MPEP 2133.03) It is further respectfully submitted that claims 2, 5, 7, 9, 10, 12, 20 and 21 are likewise novel for the reasons set forth above concerning claim 1 and the additional limitations which they introduce.

Cockrem et al.

Applicants also respectfully request reconsideration of the rejection of claims 1, 4, 6, 10, 12, 13, and 15 under 35 U.S.C. §102(b) in view of U.S. Patent No. 5,210,296 to Cockrem et al. (Cockrem et al.). Although the rejection as stated in the Office action is based upon 35 U.S.C. §102(a), applicants note that the cited reference issued more than one year before the effective filing date of the subject application.

Cockrem et al. disclose a process for recovery of lactate ester or lactic acid that comprises esterifying lactic acid (i.e., a C₃ monocarboxylic acid) with an alcohol containing 4 to

5 carbon atoms (See, for example col. 5, lines 32-35 of Cockrem et al.). As noted, claim 1 as amended requires reacting a C₄ dicarboxylic acid with methanol. Nowhere do Cockrem et al. disclose reacting a C₄ dicarboxylic acid and an alcohol and, more particularly, the reference does not disclose reacting a dicarboxylic acid with methanol as required in the process of claim 1. Accordingly, it is respectfully submitted that claim 1 and claims 6, 10, 12, 13, and 15 depending directly or indirectly therefrom are novel over the disclosure of Cockrem et al.

Schwartz et al. and Cockrem et al.

Applicants respectfully request reconsideration of the rejection of claims 1, 2, 4, 5, 7-10, 12, 14, and 20-22 under 35 U.S.C. §103(a) in view of Schwartz et al. and Cockrem et al.

As noted, Schwartz et al. fails to disclose the reaction of a dicarboxylic acid with methanol under the conditions specified in claim 1. And Cockrem et al. fail to disclose the reaction of a dicarboxylic acid with methanol under any conditions. Accordingly, it is respectfully submitted that Cockrem et al. does not cure the deficiencies of the primary reference Schwartz et al. and this combination of references relied on by the Office fails to establish a *prima facie* case of obviousness as to claim 1.

It is further respectfully submitted that it would not have been obvious for one skilled in the art to modify the disclosure of either reference to arrive at the process of claim 1. For example, Schwartz et al. describes a preference for alcohols that have from 4 to 8 carbons, have boiling points from 100°C to 200°C at atmospheric pressure, and form an azeotropic composition

with water (See, for example, page 2, lines 102-121). Methanol does not satisfy these criteria. In addition, even though methanol qualifies as an alcohol having from "one to 18 carbon atoms" as generally described by Schwartz et al., the list of suitable alcohols provided does not include methanol. See, page 2, lines 121-126. Furthermore, as noted above, none of the working examples of Schwartz et al. utilize methanol. Accordingly, it is respectfully submitted that it would not have been obvious to one skilled in the art to modify the disclosure of Schwartz et al. to utilize methanol as required in the process of claim 1.

As noted, Cockrem et al. disclose reacting a C₃ carboxylic acid (lactic acid) with an alcohol containing 4 to 5 carbon atoms. The reference includes no disclosure which would provide the basis for one skilled in the art to modify its disclosure to arrive at the claimed process for esterification of a C₄ dicarboxylic acid using methanol. Accordingly, it is respectfully submitted that the secondary reference cannot be relied on to cure the above-noted deficiencies of the primary reference.

Accordingly, it is respectfully submitted that claim 1 is not obvious in view of the disclosure of Schwartz et al. in view of the disclosure of Cockrem et al. It is further respectfully submitted that claims 2, 5, 7, 9, 10, 12, 14, and 20-22 that depend directly or indirectly from claim 1 are not obvious in view of this combination of references for the reasons set forth above regarding claim 1 and the additional limitations which they introduce.

In view of the above, favorable reconsideration and allowance of all pending claims are respectfully requested.

No Extension of Time Required

In the Office Action Summary, the period for reply "is set to expire 6 month(s) or thirty (30) days, whichever is longer, from the mailing date of this Communication." Accordingly, applicants submit that this response to the Office action dated December 12, 2007 is timely filed and that no extension of time under the provisions of 37 CFR 1.136(a) or fee are required.

If, however, an extension of time is required, the Commissioner is hereby authorized to charge the three-month extension of time fee and any other fee deficiency or overpayment in connection with this Amendment to Deposit Account No. 19-1345.

Respectfully submitted,

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